Molecular Imaging and Ovarian Cancer

Ovarian cancer is cancer that begins in the ovaries, the egg-producing female reproductive organs. The cause of ovarian cancer, the fifth most common cancer among women, is unknown. For 2011, the National Cancer Institute estimated that 21,990 women would be diagnosed with ovarian cancer in the United States and that 15,460 women would die from the disease.

Ovarian cancer is highly curable when treated at an early stage. However, because there is no effective screening test for the disease and its symptoms are often vague, the majority of women are diagnosed at a late stage when survival rates are very low.

Early detection and accurate diagnosis are essential to increasing ovarian cancer survival rates. Researchers also believe molecular imaging holds promise for detecting ovarian cancer before it spreads to other areas.

What is molecular imaging and how does it help people with ovarian cancer?

Molecular imaging is a type of medical imaging that provides detailed pictures of what is happening inside the body at the molecular and cellular level. Where other diagnostic imaging procedures—such as x-rays, computed tomography (CT) and ultrasound—predominantly offer anatomical pictures, molecular imaging allows physicians to see how the body is functioning and to measure its chemical and biological processes.

Molecular imaging offers unique insights into the human body that enable physicians to personalize patient care. In terms of diagnosis, molecular imaging is able to:

- provide information that is unavailable with other imaging technologies or that would require more invasive procedures such as biopsy or surgery
- identify disease in its earliest stages and determine the exact location of a tumor, often before symptoms occur or abnormalities can be detected with other diagnostic tests

As a tool for evaluating and managing the care of patients, molecular imaging studies help physicians:

- determine the extent or severity of the disease, including whether it has spread elsewhere in the body
- select the most effective therapy based on the unique biologic characteristics of the patient and the molecular properties of a tumor or other disease
- determine a patient’s response to specific drugs
- accurately assess the effectiveness of a treatment regimen
- adapt treatment plans quickly in response to changes in cellular activity
- assess disease progression
- identify recurrence of disease and help manage ongoing care.

Molecular imaging procedures generally are noninvasive, safe and painless.

How does molecular imaging work?

When disease occurs, the biochemical activity of cells begins to change. For example, cancer cells multiply at a much faster rate and are more active than normal cells. Heart cells deprived of adequate blood flow begin to die.

As disease progresses, this abnormal cellular activity begins to affect body tissue and structures, causing anatomical changes that may be seen on CT or magnetic resonance (MR) scans. For example, cancer cells may form a mass or tumor. With the loss of brain cells, overall brain volume may decrease or affected parts of the brain may appear different in density than normal areas. Similarly, the heart muscle cells that are affected stop contracting and the overall heart function deteriorates.

Molecular imaging excels at detecting the cellular changes that occur early in the course of disease, often well before structural changes can be seen on CT and MR images. Similarly molecular imaging can detect treatment-induced cellular activity changes earlier than structural changes.

Most molecular imaging procedures involve an imaging device and an imaging agent, or probe. A variety of agents are used to visualize cellular activity, such as the chemical processes involved in metabolism, oxygen use or blood flow. In nuclear medicine, which is a branch of molecular imaging, the imaging agent is a radiotracer, a compound that includes a very small number of radioactive atoms, or isotopes. Other molecular imaging modalities, such as optical imaging and molecular ultrasound, use different agents. MR spectroscopy is able to measure chemical levels in the body without the use of an imaging agent.

Once the imaging agent is introduced into the body, it accumulates in a target organ or attaches to specific cells. The imaging device detects the imaging agent and creates pictures that show how the agent is distributed in the body; this distribution pattern helps physicians discern how well organs and tissues are functioning.

What molecular imaging technologies are used for ovarian cancer?

The molecular imaging technologies currently being used for ovarian cancer are positron emission tomography (PET) scanning and PET in conjunction with CT scanning (PET-CT).

What is PET?

PET involves the use of an imaging device (PET scanner) and a radiotracer that is injected into the patient’s bloodstream. A frequently used PET radiotracer is 18F-fluorodeoxyglucose (FDG), a compound derived from a simple sugar and a small amount of radioactive fluorine. It usually takes between 30 and 60 minutes for the FDG to distribute
How should I prepare for a PET or PET-CT scan?

You will receive specific instructions on how to prepare based on the type of PET scan you are undergoing. In general, your preparation will involve the following:

• You should wear comfortable clothes to your appointment; you may be allowed to wear your own clothing or you may be given a gown to wear during the exam.

• If there is any possibility that you are pregnant or you are breastfeeding, you should inform your physician. You may be advised to pump and store breast milk before your procedure to be used until the PET radiopharmaceutical and CT contrast material is no longer in your body.

• You should tell your doctor what medications you are taking, if you have any allergies—especially to contrast materials, iodine, or seafood—and any other medical conditions.

• Metal objects—including jewelry, eyeglasses, dentures and hairpins—may affect the CT images and should be left at home or removed prior to your exam. You may also be asked to remove hearing aids and removable dental work.

• You will be asked not to eat anything and to refrain from drinking liquids other than water for several hours before a whole body PET-CT scan.

If you are diabetic, you may be given special instructions.

How is the procedure performed?

If necessary, you may have an intravenous line inserted into a vein in your hand or arm. A dose of radiotracer will be injected intravenously, swallowed or inhaled as a gas.

It will take approximately 60 minutes for the radiotracer to travel through your body and be absorbed. You will be asked to rest quietly during this time. You may also be asked to drink a contrast material that will help the radiologist interpreting the study or to empty your bladder.

When it is time to begin imaging, you will be positioned on an examination table and moved into the PET-CT scanner. You will need to remain still during imaging.

If you are having both a PET and CT exam, the CT scanning is usually done first, followed by the PET. The actual CT scanning takes less than two minutes, and the PET scan requires between 20 and 30 minutes.

You may be asked to wait until the technologist checks the images in case additional images are needed.

How is PET used for ovarian cancer?

Physicians use PET and PET-CT studies to:

• diagnose and stage: by determining the exact location of a tumor, the extent or stage of the disease and whether the cancer has spread in the body, especially the lymph nodes

• plan treatment: by selecting the most effective therapy based on the unique molecular properties of the disease and of the patient’s genetic makeup and to determine a site that is appropriate for biopsy, if necessary

• evaluate the effectiveness of treatment: by determining the patient’s response to specific drugs and ongoing therapy. Based on changes in cellular activity observed on PET-CT images, treatment plans can be quickly altered

• manage ongoing care: by detecting the recurrence of cancer

What are the advantages of PET studies for ovarian cancer patients?

PET-CT:

• is highly accurate at detecting recurrent ovarian cancer and more accurate than CT imaging alone

• often results in a change in patient management

• may determine the effectiveness of therapy after just one cycle of treatment

• may eliminate unnecessary surgeries after treatment by differentiating between tumors and benign residual masses

Are molecular imaging procedures covered by insurance?

Medicare and Medicaid cover PET-CT studies for many cancers, including ovarian. Major insurance companies and health maintenance organizations also provide coverage for PET-CT studies for cancer. Check with your in-
urance company for specific information on your health plan’s coverage and payment policies.

If you are being treated for a cancer that is not currently covered by insurance, you may be eligible for reimbursement by participating in the National Oncologic PET Registry (NOPR). Your physician should have more information on NOPR. Information collected in this database will help the Centers for Medicare and Medicaid Services determine whether PET scans should be covered for other types of cancer, in addition to those that are currently reimbursable under Medicare.

What is the future of molecular imaging and ovarian cancer?
There are many new and emerging molecular imaging technologies that may benefit people with ovarian cancer, including:

- hybrid imaging systems, such as combined PET-MR, which may improve accuracy and allow physicians to see how cancer is affecting other systems in the body
- new MI technologies, such as optical imaging for detection and targeted ultrasound for differential diagnosis
- new PET radiotracers to image critical cancer processes, such as fluorothymidine (FLT) and 18F-fluoroestradiol (18F-FES) to show tumor proliferation
- molecular radiotherapy (MRT)

Where can I get more information?
To learn more visit www.snmmi.org/mi or ask your physician.

The material presented in this pamphlet is for informational purposes only and is not intended as a substitute for discussions between you and your physician. Be sure to consult with your physician or the nuclear medicine department where the treatment will be performed if you want more information about this or other nuclear medicine procedures.

About SNMMI
The Society of Nuclear Medicine and Molecular Imaging (SNMMI) is an international scientific and medical organization dedicated to raising public awareness about nuclear and molecular imaging and therapy and how they can help provide patients with the best health care possible. With more than 18,000 members, SNMMI has been a leader in unifying, advancing and optimizing nuclear medicine and molecular imaging since 1954.

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